

REMARKS

Summary

Claim 8 is currently amended. Claims 6 and 14 were previously canceled. Claims 1-5, 7-13, and 15-21 are currently pending.

The amendment to claim 8 merely removes one of two options from the claim. Accordingly, another search is not needed, and so consideration of the remarks below is requested.

35 U.S.C. § 103(a)

Claims 1-4, 7, 12-13, and 15 were rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Von Behren, et al. (U.S. 2005/0107704). Claim 5 was rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Von Behren, et al. in view of Jackson, et al. (U.S. 2005/0096543). Claim 8 was rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Von Behren, et al. in view of Sui, et al. (U.S. 2005/0203395). Claim 9 was rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Von Behren, et al. in view of Jackson (U.S. 6,673,017). Claim 10 was rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Von Behren, et al. in view of Jackson '017 and further in view of Jackson, et al. (U.S. 6,193,660). Claim 11 was rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Von Behren, et al. in view of Jackson '017 and Jackson, et al. '660 and further in view of Jago, et al. (U.S. 6,117,081). Claims 16-17 and 20-21 were rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Jackson '017 in view of Jackson, et al. '660. Claim 18 was rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Jackson '017 in view of Jackson, et al. '660 and further in view of Jackson, et al. '543. Claim 19 was rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Jackson '017 in view of Jackson, et al. '660 and further in view of Jago, et al.

Claim 1 and Dependents

Claim 1 recites, *inter alia*, "displaying a breathing cycle waveform comprising the first portion." Von Behren, et al. do not teach or suggest this feature.

The Examiner argues that displaying a cycle waveform overlay is disclosed in paragraph 19 of Von Behren, et al. (Office Action, page 2). Paragraph 19 of Von Behren, et al. discloses a processor operable to match a waveform to variations of an imaging parameter and determine phase and amplitude characteristics from the matched waveform. Paragraph 19 also discloses that the processor is operable to use the phase and/or amplitude information for generating an image, an overlay or a portion of images. The images or overlay of images are not the waveform but are generated using amplitude and/or phase information *from* the waveform. There is no teaching or suggestion of displaying a waveform, let alone a breathing cycle waveform comprising a first portion.

Also, Von Behren, et al. focus on phase analysis of a heart cycle, not a breathing cycle. (Von Behren, et al., paragraph 25). The Examiner argues that it would have been obvious to one of ordinary skill in the art to modify Von Behren, et al. to monitor a breathing cycle. (Office Action, page 3). However, heart movement is drastically more rapid and different than movement of other organs based on breathing. Von Behren, et al. focuses on identifying a varying image parameter regarding heart movement. (Von Behren, et al., paragraphs 24-25). Some portions of the heart contract at different times than other portions for a given heart beat, and one feature of Von Behren, et al. is to determine the brightness of intensity that varies cyclically as a function of time during a heart beat, not a breathing cycle. Based on common sense, one of ordinary skill in the art would not modify the phase analysis features of Von Behren, et al. to monitor a breathing cycle because organ movement based on breathing and a breathing cycle are quite different than heart movement.

Accordingly, claim 1 is allowable for at least these reasons. Claims 3-5, and 9-11 depend, directly or indirectly, from allowable claim 1 and, therefore, are allowable for at least this reason.

Further limitations distinguish from the cited references, resulting in these claims being allowable. For example, claim 9 recites, *inter alia*, “determining the first portion as a function of a first reference frame of ultrasound data and a first subsequent frame of ultrasound data,” “identifying reoccurrence of the first portion of the breathing cycle,” and “repeating (b) with a second reference frame of ultrasound data associated with the reoccurrence of the first portion.” Also, claim 10 recites, *inter alia*, “repeating (b) for each cycle of the breathing cycle with a different reference frame for each breathing cycle.”

Von Behren, et al., Jackson '017, and Jackson, et al. '660 do not teach or suggest these features. Column 5, lines 53-67 of Jackson, et al. '017 disclose determining temporal offsets of frames of a cycle with respect to temporal positions relative to a base physiological cycle. Temporal offsets of different cycles are determined for interleaving by comparing a frame of a cycle with a corresponding frame of a base cycle. Column 6, lines 10-13 of Jackson, et al. '017 disclose that offsets may be determined relative to a beginning or end of the cycle, as a position along a time axis with reference to another frame or using other processes. Also, column 6, lines 36-65 of Jackson, et al. '660 disclose correlating one frame of data to another frame of data within a same set of frames to determine the position of a region of interest designator to ultimately estimate motion of anatomy. However, there is no teaching or suggestion of determining a first portion of a cycle as a function of a first reference frame of ultrasound data and a first subsequent frame. Jackson, et al. '017 disclose determination of temporal offsets using frames and Jackson, et al. '660 disclose correlation of frames for motion indication, but that is not the same as determining a portion of a cycle as a function of a reference frame.

Also, there is no teaching or suggestion of repeating the determination of the first portion of a breathing cycle with a *different reference* frame of ultrasound data associated with the reoccurrence of the first portion. Jackson, et al. '017 merely disclose that another frame rather than a corresponding frame can be used when determining offsets between a cycle and a base cycle, but that does not mean a second different reference frame is set to determine the first portion of a breathing cycle.

Determining temporal offsets using frames and correlating frames within a set of frames for a motion indication are not the same as determining a portion of a breathing cycle as a function of different reference frames. There is no teaching or suggestion of using different reference frames that correspond to a reoccurrence of a first portion of a cycle.

Also, one of ordinary skill in the art would not combine the features of Jackson, et al. '017 with Von Behren, et al. Von Behren, et al. disclose determining phase information for a plurality of spatial locations and determining B-mode variation during a heart beat. (Von Behren, et al., paragraphs 24-25). On the other hand, Jackson, et al. '017 disclose determining temporal offsets of frames of a cycle with respect to frames of a base physiological cycle. (Jackson, et al. '017, column 5, lines 53-67). The temporal offset data of Jackson, et al. '017 would be of no use to the features of Von Behren, et al. because the temporal information would not add to or aid the spatial phase analysis. Common sense would not direct one to combine the references.

Claim 2

Claim 2 recites, *inter alia*, "obtaining ultrasound data acquired over a period of time and responsive to contrast agents." Paragraph 22 of Von Behren, et al. states that data is acquired for spatial locations; in one embodiment, the data acquired is ultrasound data, such as B-mode or intensity data, and in another alternative embodiment, contrast agent data may be used. However, Von Behren, et al. concerns phase and amplitude analysis based on a heart cycle, not a breathing cycle. (Von Behren, et al., Abstract, paragraphs 16 and 21). Contrast agent imaging is used in regards to the circulatory system, *i.e.*, the heart cycle, not a breathing cycle. Contrast agents were specifically developed in order to be injected into the circulatory system. Logically, one would not use the teaching of contrast agent of Von Behren, et al. in regards to determining a portion of a breathing cycle as a function of the ultrasound data.

Claim 7 and Dependents

Claim 7 recites, *inter alia*, “identifying the first portion as a function of a trend in the breathing cycle.” Paragraph 25 of Von Behren, et al. refers to a heart cycle, not a breathing cycle. Also, paragraph 25 of Von Behren, et al. discloses a B-mode variation as a function of time over about two heart cycles, but there is no teaching of *identifying* a portion as a function of a *trend* in a cycle. Matching B-mode variation over time does not disclose identifying a portion as a function of a trend.

Accordingly, claim 7 is allowable for at least these reasons. Claim 8 depends from allowable claim 7 and, therefore, is allowable for at least this reason.

Further limitations distinguish from the cited references, resulting in claim 8 being allowable. Claim 8 recites, *inter alia*, “identifying a minimum of the breathing cycle.” None of the cited references teach or suggest identifying a minimum of a breathing cycle.

Claim 12 and Dependents

Claim 12 recites, *inter alia*, “a display operable to display a breathing cycle waveform.” The arguments above regarding claim 1 appropriately apply here as well. Accordingly, claim 12 is allowable for at least those reasons. Claims 13 and 15 depend from allowable claim 12 and, therefore, are allowable for at least this reason.

Claim 16 and Dependents

Claim 16 recites, *inter alia*, “resetting the reference frame of data for each of the plurality of subsequent cycles as a first frame of ultrasound data corresponding to the first portion of the cycle.” Arguments for similar features regarding claims 9 and 10 have been discussed above. Accordingly, those arguments appropriately apply here as well. Therefore, claim 16 is allowable for at least those reasons. Claims 17-21 depend from allowable claim 16 and, therefore, are allowable for at least this reason.

Further limitations distinguish from the cited references, resulting in these claims being allowable. For example, claims 11 and 19 relate to morphing ultrasound data frames, and the Examiner argues that this feature is taught in column 5, lines 12-33 of Jago, et al. (Office Action, pages 7 and 11). One would not combine Jago, et al. with the other references because Jago, et al. deals with spatial compounding. (Jago, et al., column 1, lines 15-27). Spatial compound imaging is performed by rapidly acquiring a series of partially overlapping component image frames from independent spatial directions (Jago, et al., column 1, lines 15-27), but the other references are interested in minimizing motions or correcting for motions while imaging from one position, not rapidly acquiring images at different angles.

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CONCLUSION:

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof. If for any reason, the Examiner is unable to allow the application but believes that an interview would be helpful to resolve any issues, he is respectfully requested to call the undersigned at (650) 694-5330 or Craig Summerfield at (312) 321-4726.

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Respectfully submitted,



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